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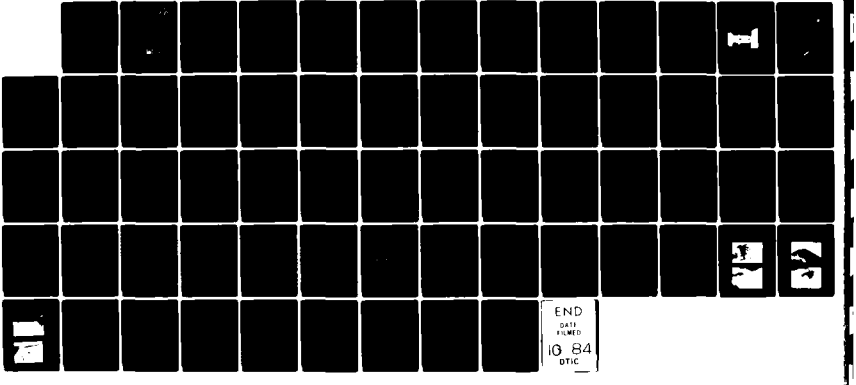

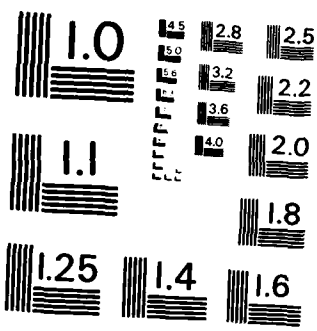

QUINEBAUG RIVER BASIN
CHARLTON , MASSACHUSETTS

GLENECHO LAKE DAM
MA 00101

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

OCTOBER 1978

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19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

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Charlton, Massachusetts

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Glenecho Lake Dam is a 255 foot long, 39 foot high earthfill dam. The zoned embankment has a core of impervious fill and a cutoff trench into glacial till. The dam is in fair condition. The dam has been placed in the "significant" hazard category. An outflow test flood (full PMF) of 3,150 cfs at El 771.1 will not overtop the dam.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF

NEDED

FEB 23 1979

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

I am forwarding to you a copy of the Glenecho Lake Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, Charlton Woolen Company, Depot Road, Charlton, Massachusetts 01508.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

GLENECHO LAKE DAM

MA 00101

QUINEBAUG RIVER BASIN
WORCESTER, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION
PROGRAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: MA00101

Name of Dam: Glenecho Lake

Town: Charlton

County and State: Worcester County, Massachusetts

Stream: Cady Brook - Tributary of the Quinebaug River

Date of Inspection: August 31, 1978

Glenecho Lake Dam is a 255-foot long, 39-foot high earthfill dam built in 1957. The zoned embankment has a core of impervious fill and a cutoff trench into glacial till. There is a concrete cut-off wall on the upstream face of the dam on both sides of the spillway. There is also a concrete retaining wall on the upstream face of the dam from the west end of the cutoff wall to the abutment. A blanket of impervious fill exists upstream of the spillway section of the dam. The spillway is a 45-foot long, ungated ogee weir with a stilling basin at the toe. The spillway is located 90 feet from the west abutment and has a crest elevation (El) of 764.3. The outlet conduit is a 24-inch, cast-iron pipe located just east of the spillway. Flow through the conduit is controlled by a 2-foot square metal slide gate housed in an access well beneath the crest of the dam. The gate is operated by a hand crank at the top of the access well. Discharge from the spillway and from the outlet is into a 50-foot wide stream bed.

There are deficiencies which must be corrected to assure the continued performance of this dam. This conclusion is based upon the visual inspection at the site, the available engineering data, and limited evidence of operational and maintenance procedures. Generally, the dam is in fair condition. According to the Corps of Engineers guidelines on classification of hazard potential, the dam has been placed in the "significant" hazard category.

The following are visible signs of distress which indicate a potential hazard at the site: cracking, tilting and settlement of the retaining wall on the upstream face of the dam;erosion at several locations on the embankment; dense growth of trees and brush on the downstream slope of the dam and in the downstream channel;lack of bedding material around riprap on the upstream slope of the dam; seepage from a hole in the downstream face of the spillway; and accumulation of rocks and other debris in the stilling basin.

Hydraulic analyses indicate that the spillway at the dam can discharge a flow of 3,600 cfs with the water surface at El 771.9 which is the low point on the crest of the dam. Therefore, an outflow test flood (full probable maximum flood) of 3,150 cfs at El 771.1 will not overtop the dam.

It is recommended that the Owner employ the services of a qualified consultant to evaluate the tilting and settlement of the retaining wall. In addition, the Owner should accomplish the following: repair erosion at various locations on the embankment, place riprap along the toe of the retaining wall on the upstream face of the dam, clear trees and brush from the downstream face of the dam and from the downstream channel, repair concrete on the weir of the spillway, and clean rocks and other debris from the stilling basin below the spillway. The Owner should also implement a systematic program of inspection and maintenance.

The recommendations and remedial measures outlined above and in Section 7 should be implemented by the Owner within a period of 2 years after receipt of this Phase I Inspection Report. An alternative to these recommendations would be to drain the pond.

Edward M. Greco, P.E.
Project Manager
Metcalf & Eddy, Inc.

Connecticut Registration
No. 08365

Approved by:

Stephen L. Bishop, P.E.
Vice President
Metcalf & Eddy, Inc.

Massachusetts Registration
No. 19703

This Phase I Inspection Report on Glenecho Lake Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Richard F. Doherty

RICHARD F. DOHERTY, MEMBER
Water Control Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph A. Mc Elroy

JOSEPH A. MCELROY, CHAIRMAN
Chief, NED Materials Testing Lab.
Foundations & Materials Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general conditions and the downstream damage potential.

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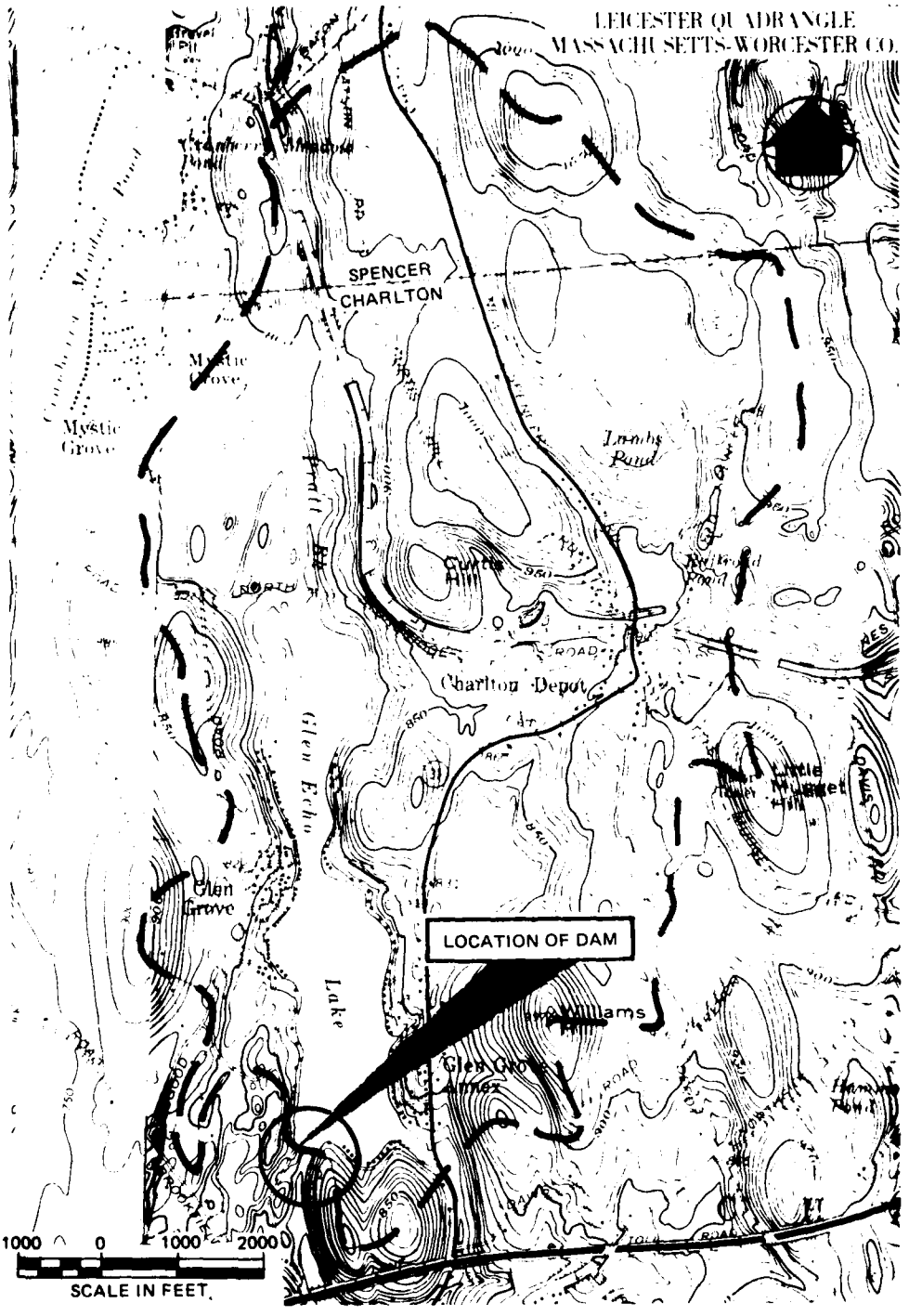
OVERVIEW
GLEN ECHO LAKE
CHARLTON, MASSACHUSETTS

VIEW FROM UPSTREAM OF WEST ABUTMENT

Location and Direction of Photographs
Shown on Figure in Appendix B



LOCATION MAP - GLENECHO LAKE DAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

GLENECHO LAKE

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Divison of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Metcalf & Eddy, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Metcalf & Eddy, Inc. under a letter of July 28, 1978, from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW 33-78-C-0306 has been assigned by the Corps of Engineers for this work.

b. Purpose:

(1) Perform technical inspection and evaluation of non-Federal dams to idenfity conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

(3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. The dam is located on Cady Brook, a tributary of the Quinebaug River, in the Town of Charlton, Worcester, County, Massachusetts (see Location Map).

b. Description of Dam and Appurtenances. Glenecho Lake Dam is an earthfill dam 255 feet long and 39 feet high (see Figures B-1, B-2 and B-3). The crest of the dam is 11 to 16 feet wide and is covered with grass. The elevation of the crest varies from 771.9 to 772.7. The embankment east of the spillway is constructed with a core of impervious fill 8 feet wide at the crest with 1/2:1 slopes. A cutoff trench beneath the core extends about 8 feet into sound impervious material which is indicated as glacial till and boulders on the boring logs (see Figure B-1). The upstream and downstream sides of the embankment are constructed of pervious fill with slopes at 2:1. The embankment west of the spillway is constructed with a core of impervious fill, and an L-shaped concrete retaining wall on the upstream face. The retaining wall is constructed slightly differently than as shown on the 1952 drawings (see Section H-H, Figure B-1). The downstream face is constructed of pervious fill at a 2:1 slope. A concrete cut-off wall is located on the upstream face of the dam and extends 20 feet from each abutment of the spillway.

The approach to the spillway has no training walls, but the floor is a berm constructed of pervious fill with an upstream slope of 2:1. This berm overlies an impervious blanket shown on the drawings to be about 8 feet thick and extends about 40 feet upstream. The spillway is a concrete ogee weir with concrete side-walls 8 to 22 feet high. The crest of the spillway is 45 feet long and is at El 764.3. The resident engineer during construction of the dam recalls that the spillway structure is founded on bedrock. The downstream face of the spillway is a steep 3:4 slope leading to a flat-bottomed, 30-foot long stilling pool. The concrete in the bottom of the pool contains three rows of

4-inch weep holes spaced on 10-foot centers. The stilling basin is filled with rocks to about a 2 foot depth. The concrete sill at the end of the stilling basin contains five horizontal drain holes at 10-foot spacing. Downstream of the sill is the channel of Cady Brook which is about 50 feet wide. The sides of the stream bed are steep earth slopes with rocks and boulders near the bottom.

The outlet for Glenecho Lake Dam is a 24-inch diameter cast iron pipe which is located beneath the dam, 5 feet east of the spillway. The pipe is shown on the drawings to be 139 feet along with an inlet on the bottom of the lake 75 feet upstream of the dam. The drawings show that the inlet is constructed with a concrete headwall around the pipe and a trash rack across the opening. The pipe is shown to have an upstream invert at El 744 and has a downstream slope of 0.003. A 4.5 foot square, 1 foot thick concrete cutoff wall (seepage collar) is shown to be constructed around the outlet pipe downstream of the crest of the dam. The downstream end of the pipe is located at the toe of the dam and is surrounded by a 5-foot high concrete headwall. Flow through the outlet is controlled by a 2-foot square metal slide gate located beneath the upstream edge of the crest of the dam. The gate is housed in a 30-foot deep access well, and a hand operated crank is located at the top of the access well.

c. Size Classification. Glenecho Lake Dam is classified in the "intermediate" category since it has a maximum height of 39 feet and a maximum storage capacity of 1,670 acre-feet.

d. Hazard Classification. Downstream of the dam is a sparsely developed, heavily wooded area for a distance of about 2,500 feet. Below this, moderate residential and commercial development exists in Charlton City, including the Charlton Woolen Company factory located on Cady Brook 3,000 feet downstream of the dam. A 25-foot high embankment of the Massachusetts Turnpike is located 1,700 feet downstream of the dam.

During the storms which occurred in 1955, the previous dam at Glenecho Lake was completely washed out. Personnel at the Charlton Woolen Company recall that there was significant property damage in Charlton City and about four lives were lost. Damage also resulted farther downstream in the Southbridge area. The embankment for the Massachusetts Turnpike acted as a dam, but flood water rose up and over the highway.

In the event of complete failure of the dam, it is unlikely that excessive property damage would occur or that more than a few lives would be lost. Accordingly, the dam is placed in the "significant" hazard category.

e. Ownership. The dam is owned by the Charlton Woolen Company, Depot Road, Charlton, Massachusetts 01508 (telephone 617-248-5811).

f. Operators. The dam is operated by personnel at the Charlton Woolen Company. The outlet gate can be opened by a hand crank located on the crest of the dam next to the spillway. The crank is kept locked with a heavy chain and padlock.

g. Purpose of Dam. Water is stored in the lake for use by the Charlton Woolen Company. The gate is kept slightly open to provide 300,000 gallons per day (gpd) of water for washing and dyeing cloth at the factory located 0.6 miles downstream. The lake is also used for recreational purposes such as fishing and boating.

h. Design and Construction History. The original dam at the site was built about 1860 and was called Hicks Pond Dam. It was constructed of earth fill with a vertical stone wall on the downstream face. In 1870, a double wall was added to support the original stone wall. A stone spillway was located about 40 feet from the west abutment, and an outlet conduit and gatehouse were located about 50 feet from the east abutment. In 1930, a bulge had developed in the downstream wall near the gate house. This bulge was buttressed with a stone wall perpendicular to

the dam. In 1936, a longer, concrete ogee weir was constructed to replace the original spillway.

In the storms of August 1955, the former dam structure was completely washed out, and ownership of the dam was temporarily transferred to the Town of Charlton. The present-day structure was built by the Massachusetts Department of Public Works, Division of Waterways, and designed by Chas. T. Main, Inc. of Boston. Construction took place in the summer of 1957. Debris and remnants of the old dam were excavated to expose a foundation of till with local outcrops of bedrock. "Soft clay" was removed beneath the upstream end of the outlet pipe and backfilled with gravel.

Since 1957, the dam has been generally in good condition. In 1964, a vertical crack was noted in the L-shaped concrete retaining wall west of the spillway on the upstream face of the dam. This condition has not been repaired.

1. Normal Operating Procedures. Under normal conditions, the outlet gate is maintained slightly open. Occassionally, the gate is opened in advance of storms or to allow property owners around the lake to work on their waterfront areas. Personnel at the Charlton Woolen Company have the key to open the lock to operate the crank for the outlet gate.

1.3 Pertinent Data

a. Drainage Area. The approximately 1,836 acre (2.87 square mile) drainage area includes the drainage areas of Lambs Pond and Railroad Pond located about 1.5 miles northeast of the dam on Cady Brook. Glenecho Lake actually lies mostly in the valley of Pratt Brook which flows from the north and joins Cady Brook. The drainage area is generally sparsely developed, wooded, and gently rolling. There is moderate residential development around the lake.

b. Discharge. Normal discharge is over the spillway which is ungated. The spillway is 45 feet long, with an ogee crest at El 764.3. Water flows down a 17-foot high concrete surface and into a flat-bottomed stilling pool covered with rock and debris. The pool extends about 30 feet downstream, and water flows over a concrete sill at the downstream end of the stilling pool and into Cady Brook. The stream bed is about 50 feet wide and is covered with rock fill and boulders for a distance of several hundred feet downstream. The stream has a gradient of about 1 percent.

The spillway can discharge an estimated 3,600 cfs with the water surface at El 771.9 which is the low point on the crest of the dam. The outflow test flood (full PMF) is 3,150 cfs at El 771.1 and will not overtop the dam.

The maximum flood level at the present dam is unknown. The original dam was not overtopped in 1938, but it was completely washed out by the storms in August 1955.

c. Elevation (feet above Mean Sea Level (MSL)). A benchmark at El 764.3 was established at the spillway crest. This elevation was shown on drawings of the dam dated 1956 (see Figure B-1).

(1) Top dam: 771.9 to 772.7.

(2) Test flood pool: 771.1

(3) Design surcharge (1956 design): Maximum Design Flow El 769.3

(4) Full flood control pool: Not Applicable (N/A)

(5) Recreation pool: 764.3

(6) Spillway crest (ungated): 764.3

(7) Upstream portal invert diversion tunnel: N/A

(8) Stream bed at centerline of dam: 741.5

(9) Maximum tailwater: 743.9

d. Reservoir

(1) Length of maximum pool: 6,200 feet

(2) Length of recreation pool: 6,200 feet

(3) Length of flood control pool: N/A

e. Storage (acre-feet)

(1) Test flood surcharge: 762 (Net) at El 771.1

(2) Top of dam: 1,670

(3) Flood control pool: N/A

(4) Recreation pool: 820 (Approximate)

(5) Spillway crest: 820

f. Reservoir Surface (acres)

*(1) Top dam: 112

*(2) Test flood pool: 112

(3) Flood-control pool: N/A

(4) Recreation pool: 112

(5) Spillway crest: 112

g. Dam

(1) Type: earthfill

(2) Length: 255 feet

(3) Height: 39 feet

(4) Top width: varies from 11 to 16 feet

*Based on the assumption that the surface area will not increase significantly with changes in reservoir elevation from 764.3 to 771.9

(5) Side slopes: upstream - 2:1 to vertical wall; downstream - 2:1

(6) Zoning: impervious core with outer zone of pervious fill

(7) Impervious core: earth

(8) Cutoff: cutoff trench beneath core, upstream impervious blanket, cutoff wall next to spillway, seepage collar around outlet pipe

(9) Grout curtain: none

i. Spillway

(1) Type: ogee

(2) Length of weir: 45 feet

(3) Crest elevation: 764.3 MSL (assumed benchmark)

(4) Gates: None

(5) Upstream channel: bottom is pervious fill placed on top of impervious upstream blanket; no approach walls

(6) Downstream channel: flat, concrete stilling pool at toe extends 30 feet downstream; leads to 50 foot wide stream bed covered with rock fill

(7) General: 10 foot high by 14 foot wide concrete box culvert is located 1,700 feet downstream beneath Massachusetts Turnpike

j. Regulating Outlets. The regulating outlet at the dam is a 24-inch diameter cast iron pipe located adjacent to the east abutment of the spillway. The pipe is shown on drawings to be 139 feet long with an invert at El 744. The inlet to the conduit is located upstream on the bottom of the lake, and the outlet is at the toe of the dam. Flow is controlled by a 24-inch square metal slide gate housed inside an access well beneath the crest of the dam. The gate is operated by a hand crank located at the top of the access well.

SECTION 2

ENGINEERING DATA

2.1 General. There are three sheets of drawings dated August 1956 available from the Worcester County Commissioners' Office showing the proposed reconstruction of Glenecho Lake Dam (copies included in Appendix B). Personnel from Chas. T. Main, Inc. stated that as-built drawings were probably not made because the dam was constructed essentially as proposed. Standard specifications by the Massachusetts Division of Waterways were used for construction of the dam. There is also a drawing dated September 1936 available from the County showing a plan and sections of the original dam and the proposed construction of a new ogee spillway. No other plans, specifications, or computations are available from the Owner, State, County or Chas. T. Main, Inc. relative to the design, construction, or repair of this dam.

We acknowledge the assistance and cooperation of personnel of the Massachusetts Department of Public Works: Messrs. Willis Regan and Raymond Rochford, and of the Massachusetts Department of Environmental Quality Engineering, Division of Waterways: Messrs. John J. Hannon and Joseph Iagallo.

Also, we acknowledge the cooperation and assistance of personnel from the Worcester County Engineer's Office: Messrs. John O'Toole and Joseph Brasauskas.

In addition, we thank Mr. Reed Grimwade of the Charlton Woolen Company who provided information on the operation and past performance of the dam.

We also acknowledge the assistance of Messrs. Charles Benziger, Llewellyn Cross, Jr., and John Goodrich of Chas. T. Main, Inc. who searched their files for additional design data.

2.2 Construction Records. The only construction records are the 1956 Plans referred to in Section 2.1 and included in Appendix B. There are no as-built drawings for the dam, spillway or outlet structures.

2.3 Operating Records. No operating records are available, and there is no daily record kept of the elevation of the pool or rainfall at the dam site.

2.4 Evaluation

a. Availability. There is limited engineering data available.

b. Adequacy. The lack of detailed hydraulic, structural, and construction data did not allow for a definitive review. Therefore, the evaluation of the adequacy of this dam is based on review of available drawings, visual inspection, past performance history, and engineering judgment.

c. Validity. Comparison of the available drawings with the field survey conducted during the Phase I inspection indicates that the information is valid.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The Phase I Inspection of the dam at Glenecho Lake was performed on August 31, 1978. A copy of the inspection check list is included in Appendix A. Previous inspections of this dam and of the original dam at this site have been made by others since 1925. A partial listing of these inspections is in Appendix B. An inspection was made in 1972 by personnel from the Massachusetts Department of Public Works. A copy of their report is included in Appendix B.

b. Dam. Glenecho Lake Dam consists of an earth embankment with a core of impervious fill. A concrete cutoff wall is located on the upstream face of the dam and extends 20 feet from each side of the spillway. An L-shaped concrete retaining wall is on the upstream face from the cutoff wall to the west abutment. The dam is generally in fair condition. No seepage from the embankment of the dam was observed, however, several signs of distress were noted at the site. First, a vertical crack has developed in the L-shaped concrete retaining wall about midway between the spillway and the west abutment. This crack has opened in the upstream direction to 0.5 inch wide at the top of the wall and has opened downward to 2.5 inches wide at the bottom of the wall. Settlement of the crest has produced a 5.75 inch deflection of the wall in the upstream direction. The crack continues through the concrete footing at the bottom of the wall. There is no significant riprap present, and some undercutting of the footing has occurred.

A second sign of distress is erosion at various locations on the dam. West of the spillway, there is a gully along the upstream edge of the crest next to the concrete retaining wall. This gully appears to be due to erosion from surface runoff, but is also probably due to settlement behind the cracked wall. The gully leads to an

eroded area at the west end of the retaining wall. There is no significant riprap protection at the west abutment or along the bottom of most of the retaining wall. There are tire ruts in the crest of the dam west of the spillway. Footpaths 1 foot deep have been worn on the downstream slope of the dam next to both abutments of the spillway. A gully formed by surface runoff also occurs on the downstream slope at the east abutment.

A third sign of distress is the very thick growth of trees and brush on the downstream slope of the dam. The crest and upstream slope are fairly clear, although some brush is growing along the upstream edge of the crest east of the spillway.

A fourth sign of distress is the condition of the riprap on the upstream face of the dam east of the spillway. There is no backing material behind the blocks of rock. Grass and weeds are growing between the pieces of riprap, and a few blocks are missing.

c. Appurtenant Structures. The spillway is a 45-foot long, concrete ogee weir located about 90 feet from the west abutment of the dam. There is a flat-bottomed, concrete stilling pool at the toe of the weir. The stilling pool extends about 30 feet downstream with a concrete sill at the end.

Water is seeping from a small hole at a vertical construction joint in the downstream face of the weir. The hole is located in about the middle of the weir and near the bottom at about El 752.5. There is an accumulation of rock and debris about 2 feet deep in the bottom of the stilling pool. Staining from seepage was noted near the top of a vertical construction joint on the east wall of the spillway.

The outlet conduit is a 24-inch diameter cast iron pipe which passes beneath the dam just east of the spillway. The inlet to the conduit is shown on the drawings as located on the bottom of the lake 75 feet upstream of the dam. The condition of the inlet was not visible at

the time of inspection. An access well is located at the upstream edge of the crest of the dam and houses the slide gate. The top of the access well was opened, but the metal stairs inside were corroded, and therefore an inspection could not be made. A log was found to be inside the access well. Staining from seepage was noted along a construction joint inside the well. A metal hand crank at the surface for operating the slide gate is in good condition and kept locked.

The downstream end of the outlet conduit is surrounded by a 5-foot high concrete headwall. There is a separation between the top of the pipe and the opening in the wall. This is due to the loss of caulking from around the pipe. The wall is otherwise in good condition. The end of the pipe does not contain soil or debris and is discharging water into the stream.

d. Reservoir Area. The area around Glenecho Lake is moderately developed with about 150 residences and summer cottages. Water supply to the cottages is from ground water wells adjacent to the lake. It is possible that more development could occur in the future. The area is wooded and grassed and has moderate slopes of 5 to 15 percent.

e. Downstream Channel. Discharge from the spillway and outlet enters the valley of Cady Brook which is about 50 feet wide. The bottom is covered with rock fill and boulders and is thickly overgrown with trees and brush. The sides of the valley are steep slopes of glacial till and densely wooded. There are several gullies 1 to 3 feet deep eroded by surface runoff on the east slope of the valley.

Water flows downstream at a gradient of about 1 percent. At 1,700 feet from the dam, water enters a 10-foot high by 14-foot wide concrete box culvert which is located beneath a 25-foot high embankment of the Massachusetts Turnpike.

Flow continues downstream in a narrow, undeveloped valley toward the center of Charlton City which begins about 2,500 feet from the dam. The town is moderately developed, and two small dams

are located on Cady Brook. One of these forms a pond at the Charlton Woolen Company located 3,000 feet downstream of the dam.

3.2 Evaluation. The above findings indicate that the dam is in fair condition, and there are several deficiencies which require attention. It is evident that the dam is not adequately maintained. Recommended measures to improve these conditions are stated in Section 7.3.

SECTION 4

OPERATING PROCEDURES

4.1 Procedures. Under normal conditions, the outlet gate at the dam is kept slightly open to provide a 300,000 gpd supply of water to the Charlton Woolen Mill located 0.6 miles downstream. Occasionally, personnel from the mill unlock the chain on the hand crank and open the gate in advance of storms or to allow property owners around the lake to work on their waterfronts. The last time the gate was opened was about 2 years ago when the Massachusetts Division of Waterways contacted the Owner to have the gate opened in anticipation of a hurricane. Personnel at the woolen mill indicate that if the pond level is lowered significantly, then water supply wells around the lake become dry.

4.2 Maintenance of Dam. The dam is not adequately maintained. The crack in the L-shaped retaining wall west of the spillway was noted in an inspection report dated 1964. Erosion at various locations on the embankment has not been repaired. A dense growth of trees and brush occurs on the downstream slope and in the channel of Cady Brook. The concrete in the spillway needs repair, and the stilling pool should be cleaned out.

4.3 Maintenance of Operational Facilities. Only the downstream end of the outlet conduit, and the access well containing the slide gate were visible at the time of inspection. The outlet pipe appears to be in good condition. An opening exists between the pipe and the concrete headwell which is due to the loss of caulking material. Also, the metal steps leading into the access well are corroded, and a log is lying inside.

4.4 Description of Any Warning Systems in Effect. There is no warning system in effect at this dam. However, in the past, the Massachusetts Division of Waterways has alerted the Owner to open the slide gate when a storm was anticipated.

4.5 Evaluation. There is no regular program of maintenance or warning system in effect at Glenecho Lake Dam. This is undersirable considering the

dam is in the "significant" category. A program of inspection and maintenance and a surveillance system for this dam should be implemented as recommended in Section 7.3.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data. The Probable Maximum Flood (PMF) rate was determined to be 1,500 cfs per square mile. This calculation is based on the average slope of the drainage area of 4 percent, the pond- plus-swamp area to drainage area ratio of 13 percent, and the U.S. Army Corps of Engineers' guide curves for Maximum Probable Flood Peak Flow Rates (dated December 1977). Applying the full PMF to the 2.87 square miles of drainage area results in a calculated peak flood flow of 4,300cfs as the inflow test flood. By adjusting the inflow test flood for surcharge storage, the maximum discharge rate was established as 3,150 cfs (1,100 cfs per square mile), with a water surface at El 771.1

There are no detailed hydraulic computations available for this dam. However, the drawings dated 1956 (see Figure B-1) indicate a "maximum design flow El 769.3" for the spillway.

Hydraulic analyses indicate that the spillway could discharge 3,600 cfs when the water surface is at El 771.9 which is the low point on the crest of the dam. This discharge exceeds the outflow test flood of 3,150 cfs. Using the outflow test flood, the pond level would be 0.8 feet below the low point on the crest.

With the pond level at 0.5 feet above the spillway crest, the low level outlet can discharge about 54 cfs.

b. Experience Data. During the storms which occurred in 1955, the previous dam at Glenecho Lake was completely washed out. Personnel at the Charlton Woolen Company recall that there was significant property damage in Charlton City and about 4 lives were lost. Damage also resulted farther downstream in the Southbridge area. The embankment for the Massachusetts Turnpike acted as a dam, but flood water rose up and over the highway.

c. Visual Observations. Discharge from Glenecho Lake is over an ungated, ogee-shaped spillway. The discharge flows into a stilling basin and then continues downstream in a natural channel. The spillway is unlikely to clog, unless blocked by a large tree, floating structure, or similar sizeable item. A minor leak was observed at a vertical construction joint on the downstream face of the spillway. The stilling basin contained considerable debris. If the debris is allowed to accumulate, it could hinder the operation of the basin.

A low level outlet discharges at the toe of the dam just east of the spillway. Flow through the pipe is controlled by a slide gate at the bottom of an access well near the center of the dam. The gate is reportedly operable and maintained slightly open.

d. Overtopping Considerations. The full P.M.F. storm can be discharged over the spillway at Glenecho Lake Dam, with a freeboard of 0.8 feet.

Based on the possible failure of the earth embankment during the test flood, the peak discharge rate would increase from 3,150 cfs to 4,930 cfs and produce a downstream flood wave of 2 feet surcharged on the 9 foot flood flow in the channel. Since the area downstream of the dam is sparsely developed and heavily wooded for a distance of about 2,500 feet, it is unlikely that any major damage would occur due to failure of the dam. However, the sizeable volume of water released would probably cause severe flooding in Charlton.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The evaluation of the structural stability of Glenecho Lake Dam is based on review of available drawings and the visual inspection conducted on August 31, 1978. As discussed in Section 3, Visual Inspection, the dam is in fair condition. A crack exists in the L-shaped retaining wall west of the spillway. This has opened in the upstream direction and produced about a 6-inch tilt toward the lake. This condition was noted in a previous inspection report dated 1964.

Based on this observation, the embankment of the dam is a potential hazard. It is recommended that a more detailed investigation be conducted to evaluate the tilting and settlement of the retaining wall.

b. Design and Construction Data. There are three sheets of drawings dated 1956 available from the County on the design and construction of this dam (see Figures B-1, B-2, and B-3). A discussion with the resident engineer at Chas. T. Main, Inc., indicated that these drawings are representative of the actual construction of the dam. There are no other plans, specifications or computations available on the design, construction, or repair of this dam from the Owner, County, State, or Chas. T. Main, Inc.

Information does not appear to exist on the type, shear strength, and permeability of the soil and/or rock materials of the embankment. Borrow material for the embankment was obtained from an area near the east abutment of the dam.

Glenecho Lake Dam was built in 1956 after the previous dam was washed out by the 1955 hurricane. Drawings indicate that the embankment east of the spillway contains a core of impervious fill 8 feet wide at the crest with 1/2:1 slopes. Beneath this core is a cutoff trench

which extends about 8 feet into impervious foundation material which is glacial till. The embankment around the core is made of pervious fill with upstream and downstream slopes of 2:1. The embankment west of the spillway is constructed with a core of impervious fill and a concrete retaining wall on the upstream face. The downstream face is made of pervious fill at a slope of 2:1. A concrete cutoff wall exists on the upstream face of the dam and extends 20 feet from each wall of the spillway.

The drawings show an impervious blanket located upstream of the spillway section of the dam. The blanket is 8 feet thick and extends about 40 feet upstream. It is covered with pervious fill which forms the floor of the approach to the spillway.

A 4.5-foot square by 1 foot thick concrete cutoff wall is constructed around the outlet conduit to prevent piping. The wall is shown on the drawings to be located about 5 feet downstream from the crest of the dam. The bottom of the wall is keyed into undisturbed material.

c. Operating Records. There is no instrumentation of any type in Glenecho Lake Dam, and no instrumentation was ever installed in this dam. The performance of this dam under prior loading can only be inferred by physical evidence at the site.

d. Post-Construction Changes. There are no as-built drawings available for Glenecho Lake Dam. Based on discussions with Chas. T. Main, Inc., visual evidence, and field measurements, the dam appears to be built essentially as shown on the 1956 drawings.

e. Seismic Stability. The dam is located in Seismic Zone No. 2 and in accordance with Phase I "Recommended Guidelines" does not warrant seismic analyses.

SECTION 7

ASSESSMENT, RECOMMENDATIONS,
AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Based upon a review of available drawings, the visual inspection of the site and limited operational or maintenance information, there are deficiencies which must be corrected to assure the continued performance of this dam. Generally, the dam is considered to be in fair condition. However, several signs of distress were observed at the site: cracking and settlement of the L-shaped retaining wall west of the spillway, lack of riprap along the bottom of the wall, erosion at several locations on the embankment, dense growth of trees and brush on the downstream slope of the dam and in the downstream channel, seepage from a hole in the downstream face of the spillway, and accumulation of rocks and other debris in the stilling basin.

Hydraulic analyses indicate that the spillway can discharge a flow of 3,600 cfs with the water surface at El 771.9 which is the low point on the crest of the dam. An outflow test flood of 3,150 cfs (full probable maximum flood) will not overtop the dam.

b. Adequacy. The lack of detailed design and construction data did not allow for a definitive review. Therefore, the evaluation of the adequacy of this dam is based primarily on review of available drawings, visual inspection, past performance and engineering judgment.

c. Urgency. The recommendations and remedial measures outlined below should be implemented by the Owner within 2 years after receipt of this Phase I Inspection Report.

d. Need for Additional Investigation. Additional investigations to further assess the adequacy of the dam are outlined below in Section 7.2 Recommendations.

7.2 Recommendations. In view of the concerns over the continued performance of the dam, it is recommended that the Owner employ a qualified consultant to evaluate the tilting and settlement of the retaining wall on the upstream face of the dam.

Recommendations on repairs and maintenance procedures are outlined below under Section 7.3, Remedial Measures.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The dam and appurtenant structures are not adequately maintained. It is recommended that the Owner accomplish the following:

(1) backfill and protect eroded areas on the crest and slopes of the embankment

(2) place riprap along the toe of the retaining wall on the upstream face of the dam

(3) clear trees and brush from the downstream slope of the dam and from the downstream channel

(4) repair the leak in the downstream face of the spillway

(5) clean accumulated rock and other debris from the stilling basin below the spillway

(6) implement a systematic program of maintenance inspections. As a minimum, the inspection program should consist of a monthly inspection of the dam and appurtenances, supplemented by additional inspections during and after severe storms. All repairs and maintenance should be undertaken in accordance with all applicable State regulations.

(7) periodic technical inspections of this dam should be continued on an annual basis

(8) institute a definite plan for surveillance and a warning system during periods of unusually heavy rains and/or runoff.

7.4 Alternatives. An alternative to implementing the recommendations and the maintenance procedures listed above would be to drain the pond. This could be an undesirable alternative, since lowering the lake causes nearby ground water wells to become dry.

APPENDIX A

PERIODIC INSPECTION CHECKLIST

GLENECHO LAKE DAM

PERIODIC INSPECTION

PARTY ORGANIZATION

PROJECT Glenecho Lake Dam

DATE Aug 31, 1978

TIME 8:00-12:00 AM

WEATHER cloudy, lt rain, 70°

W.S. ELEV. 764.2 U.S. 743.9 M.S.L.
*assumed benchmark El 764.3 on spillway crest

PARTY:

1. Mike Larson
2. Lyle Branagan
3. Carol Sweet
4. Sue Pierce
5. David Cole
6. Frank Sviokla
7. Henry Lord
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	dam	Larson / Sweet	
2.	spillway	Larson / Branagan	
3.	outlet conduit	Larson / Branagan	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT Glenecho Lake Dam DATE August 31, 1978

PROJECT FEATURE dam NAME Mike Larson

DISCIPLINE geotechnical NAME Carol Sweet

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	varies from 771.9 to 772.7
Current Pool Elevation	764.2
Maximum Impoundment to Date	unknown
Surface Cracks - none crest condition -	tire tracks + ruts in crest west of spillway
Pavement Condition	no pavement
Movement or Settlement of Crest	vertical settlement along concrete retaining wall west of spillway
Lateral Movement	bulge in upstream direction at crack in concrete retaining wall
Vertical Alignment	good - relatively flat
Horizontal Alignment	embankment west of spillway - straight; east of spillway - curved
Condition at Abutment and at Concrete Structures	tie into natural hillsides - erosion on US face west abutment - gully on DS face east abutment
Indications of Movement of Structural Items on Slopes	lateral movement of concrete retaining wall west of spillway - deflection 5.75" in upstream direction
Trespassing on Slopes	footpaths along DS face of both spillway abutments
Sloughing or Erosion of Slopes or Abutments	erosion at end of concrete retaining wall, US face, near west abutment - footpaths along spillway - gully on DS slope east abutment
Rock Slope Protection - Riprap Failures	rip rap east of spillway - no bedding material, some pieces missing; west of spillway
Unusual Movement or Cracking at or near Toes	no significant rip rap along concrete retaining wall none visible - heavily overgrown
Unusual Embankment or Downstream Seepage	possible seepage in downstream channel obscured by rock fill
Piping or Boils	none visible
Foundation Drainage Features	4 horizontal drain holes in sill at DS end of stilling pool
Toe Drains	none visible
Instrumentation System	none visible

PERIODIC INSPECTION CHECK LIST

PROJECT Glenecho Lake Dam DATE August 31, 1978

PROJECT FEATURE Spillway NAME Mike Larson

DISCIPLINE geotechnical NAME Lyle Branagan

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	no training walls - bottom not visible
General Condition	clear - no visible obstructions
Loose Rock Overhanging Channel	none
Trees Overhanging Channel	none
Floor of Approach Channel	not visible
b. Weir and Training Walls	concrete side walls + chain fence at top concrete ogee weir, stilling basin at toe
General Condition* of Concrete	Very good except hole near bottom of DS face of weir along vertical construction joint - water seeping clear
Rust or Staining	stain from seepage near top of construction joint - east side wall - 20' DS of crest
Spalling	minor surface scouring on weir and sill below stilling basin
Any Visible Reinforcing	none visible
Any Seepage or Efflorescence	seepage from small hole in face of weir
Drain Holes	horizontal holes in sill below stilling basin; vertical holes in floor of stilling basin (not visible)
c. Discharge Channel**	stream bed w/rocks + boulders in floor and steep earth side slopes
General Condition	fair - several trees in channel, thickly overgrown, some trash debris
Loose Rock Overhanging Channel	none
Trees Overhanging Channel	both side slopes have numerous large trees + are densely overgrown
Floor of Channel	several large trees, densely overgrown, some trash debris
~~Other Obstructions~~ EROSION	several gullies 1'-2' deep eroded in steep side slope east of channel

*accumulation of rock + trash debris ± 2' deep in floor of stilling basin - possibly rock washed over weir

** culvert beneath Massachusetts TPKE @ 1700' DS 10'H x 14'W - concrete sides + roof, asphalt floor

PERIODIC INSPECTION CHECK LIST

PROJECT Glenecho Lake Dam DATE August 31, 1978

PROJECT FEATURE outlet conduit NAME Mike Larson

DISCIPLINE geotechnical NAME Lyle Branagan

AREA EVALUATED	CONDITION
OUTLET WORKS* - OUTLET STRUCTURE AND OUTLET CHANNEL	5' high concrete headwall around outlet conduit (24" dia cast-iron pipe)
General Condition of Concrete	very good
Rust or Staining	very slight
Spalling	none
Erosion or Cavitation	none
Visible Reinforcing	none
Any Seepage or Efflorescence	none
Condition at Joints	separation between top of pipe and opening in headwall - caulking gone
Drain Holes	none
Channel	stream bed - same as for spillway
Loose Rock or Trees Overhanging Channel	numerous large trees on sides and floor of channel - thick brush growth
Condition of Discharge Channel	filled with rocks & boulders, some trash gullies eroded in east side slope

* intake structure located upstream of dam on bottom of lake - not visible during inspection - shown on drawings as having a concrete headwall with trash rack across conduit opening

see page A-5 for description of slide gate & access well

PERIODIC INSPECTION CHECK LIST

PROJECT Glenecho Lake Dam DATE August 31, 1978

PROJECT FEATURE outlet gate NAME Mike Larson

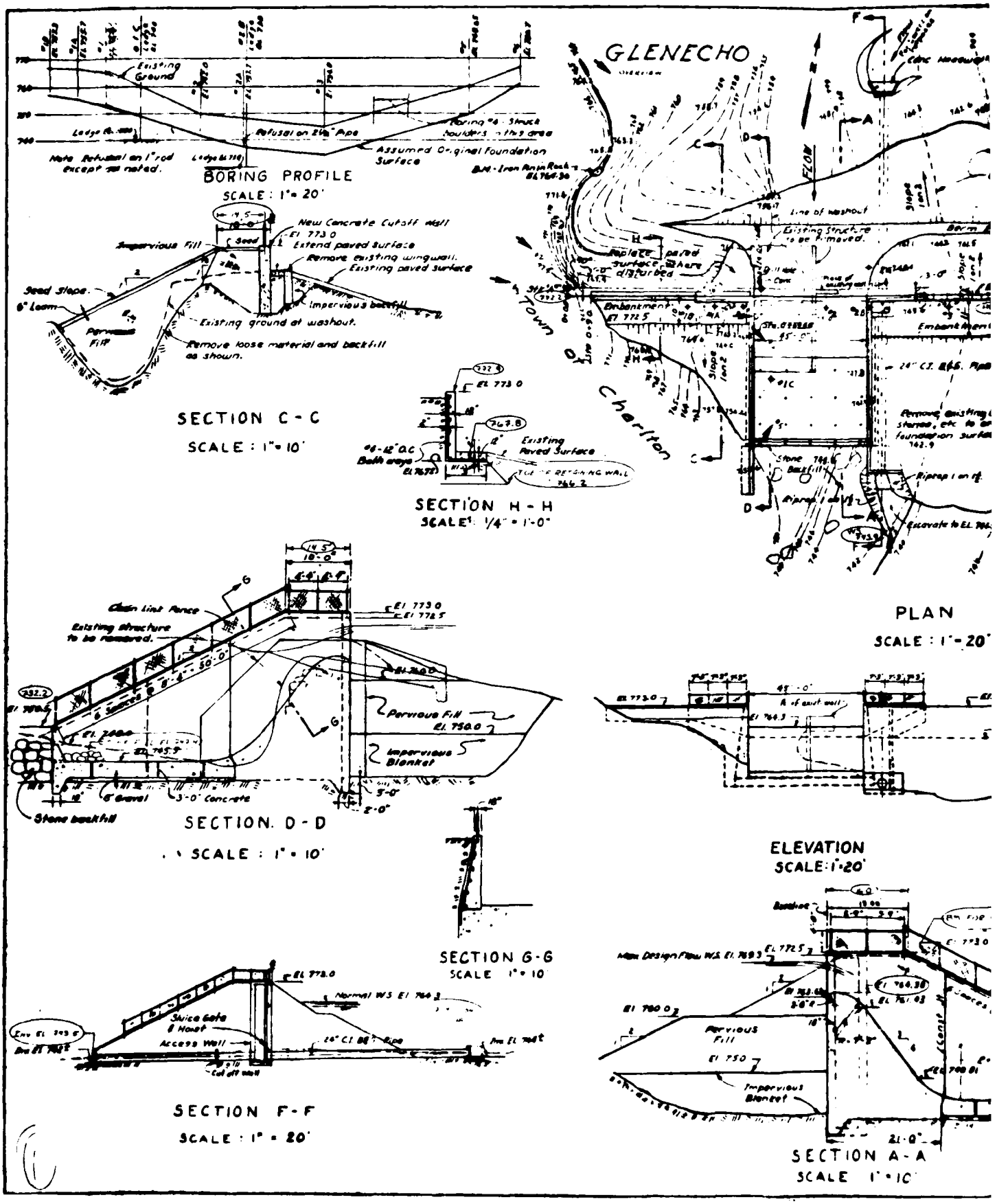
DISCIPLINE geotechnical NAME Kyle Branagan

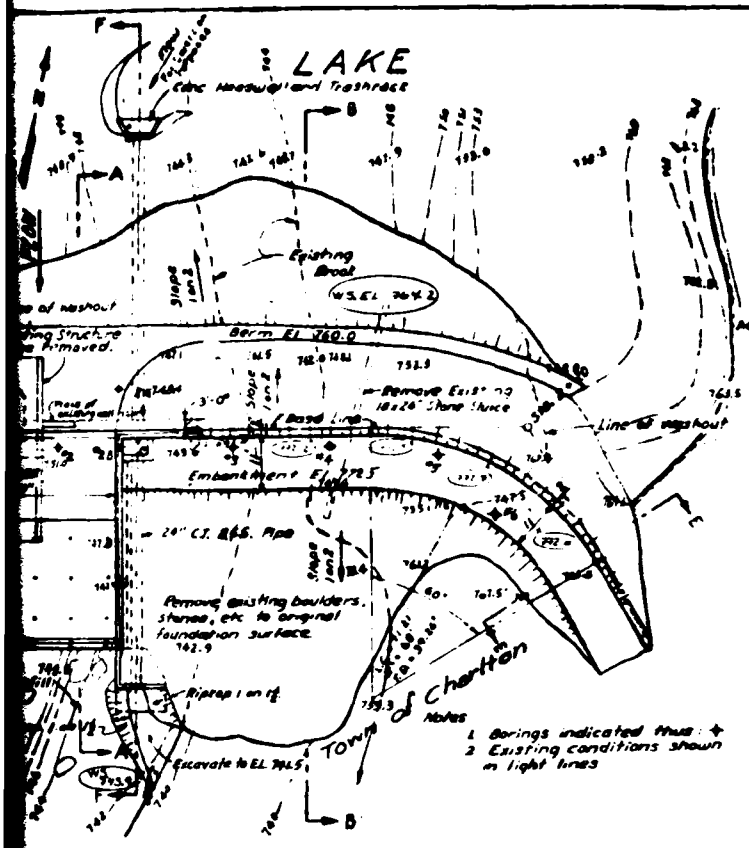
AREA EVALUATED	CONDITION
OUTLET WORKS - ~~CONTROL TOWER~~ SLIDE GATE + ACCESS WELL	
a. Concrete and Structural	could not go inside well because stairs were corroded - inspection done from surface looking inside
General Condition	good - log lying inside well
Condition of Joints	some stain from seepage
Spalling	none visible
Visible Reinforcing	none visible
Rusting or Staining of Concrete	along construction joint
Any Seepage or Efflorescence	none visible
Joint Alignment	good
Unusual Seepage or Leaks in Gate	gate open - 2' square metal gate
Cracks	none visible
Rusting or Corrosion of Steel	metal stairs into well are corroded
b. Mechanical and Electrical	none present - hand crank at surface to operate gate - crank in good condition with chain and lock
Air Vents	
Float Wells	Not Applicable (N/A)
Crane Hoist	N/A
Elevator	N/A
Hydraulic System	N/A
Service Gates	N/A
Emergency Gates	N/A
Lightning Protection System	N/A
Emergency Power System	N/A
Wiring and Lighting System in Gate Chamber	N/A

APPENDIX B

PLANS OF DAM AND PREVIOUS
INSPECTION REPORTS

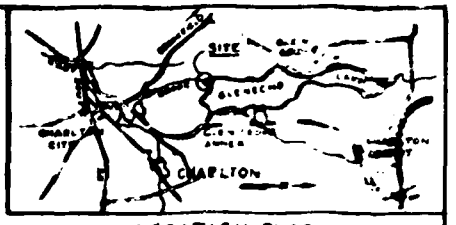
	Page
Figures B-1, B-2, and B-3 Drawings of Dam, dated August 1956	B-1
Previous Inspections (Partial Listing)	B-4
Inspection by Mass. Department of Public Works, dated February 17, 1972	B-6


GLENECHO
Existing Ground
Refusal on 2½" Pipe
Assumed Original Foundation Surface
BORING PROFILE
SCALE : 1" = 20'
New Concrete Cutoff Wall
Extend paved surface
Remove existing wingwall.
Existing paved surface
Impervious backfill
Existing ground at washout.
Remove loose material and backfill as shown.
Seed Slope
6" Loam
Pervious Fill
SECTION C - C
SCALE : 1" = 10'
Existing Paved Surface
SECTION H - H
SCALE: 1/4" = 1'-0"
Town of Cheriton
Line of washout
Existing Structure to be removed.
Replace paved surface disturbed
Embankment
Stone Backfill
Riprap
Excavate to EL
PLAN
SCALE : 1" = 20'
Chain Link Fence
Existing Structure to be removed.
Pervious Fill
Impervious Blanket
6" Gravel
3'-0" Concrete
Stone backfill
SECTION D - D
SCALE : 1" = 10'
ELEVATION
SCALE: 1" = 20'
SECTION G-G
SCALE 1" = 10'
Sluice Gate
Hoist
Access Wall
Normal WS El 764.3
20" CI
SECTION F - F
SCALE : 1" = 20'
Basshoe
Pervious Fill
Impervious Blanket
SECTION A - A
SCALE 1" = 10'



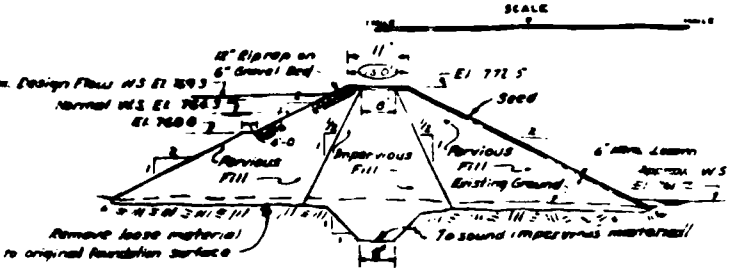
PLAN

SCALE : 1" = 20'



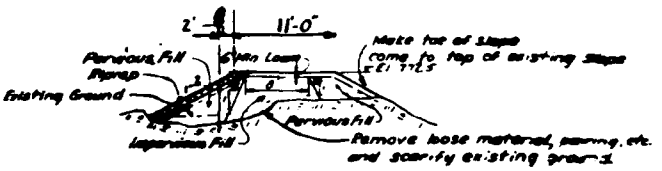
LOCATION PLAN

SCALE



SECTION B - B

SCALE : 1" = 20'



SECTION E - E

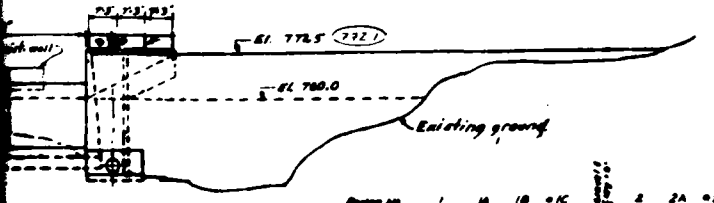
SCALE : 1" = 10'

NOTES:

3. (992.2) INDICATES ELEVATIONS AND MEASUREMENTS FROM FIELD SURVEY BY METCALF AND EDDY, INC. ON AUGUST 31, 1955
4. ELEVATIONS BASED ON ASSUMED BENCHMARK ON SPILLWAY CREST, EL. 769.3 (MSL)
5. DENOTES DIRECTION OF VIEW OF PHOTOGRAPHS.
6. DRAWING HAS BEEN REDUCED FOR THIS REPORT.

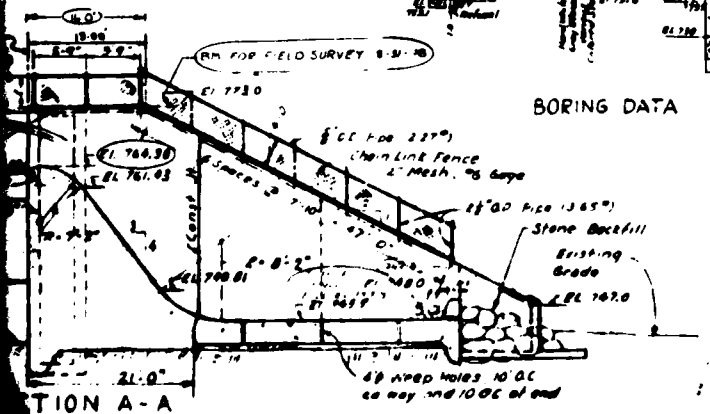
NOTES

1. Elevations refer to mean sea level.
2. B.M. Iron Pin in rock on west bank EL 764.30



NOTE:
1. Rod sampler driven with 140# hammer, 30" drop at depth indicated. Numbers in log indicate blows per ft.

BORING DATA



TION A-A

E : 1" = 10'

SUBMITTED Dec 13 1956	APPROVED Dec 19 1956
COUNTY ENGINEER	Chairman, County Commissioners
DAM NO 10-12	

FIGURE B-1

PROPOSED DAM RESTORATION

GLENECHO LAKE

CHARLTON

PLAN, ELEVATION & SECTIONS

DEPARTMENT OF PUBLIC WORKS OF MASSACHUSETTS
DIVISION OF WATERWAYS

AUGUST 1956

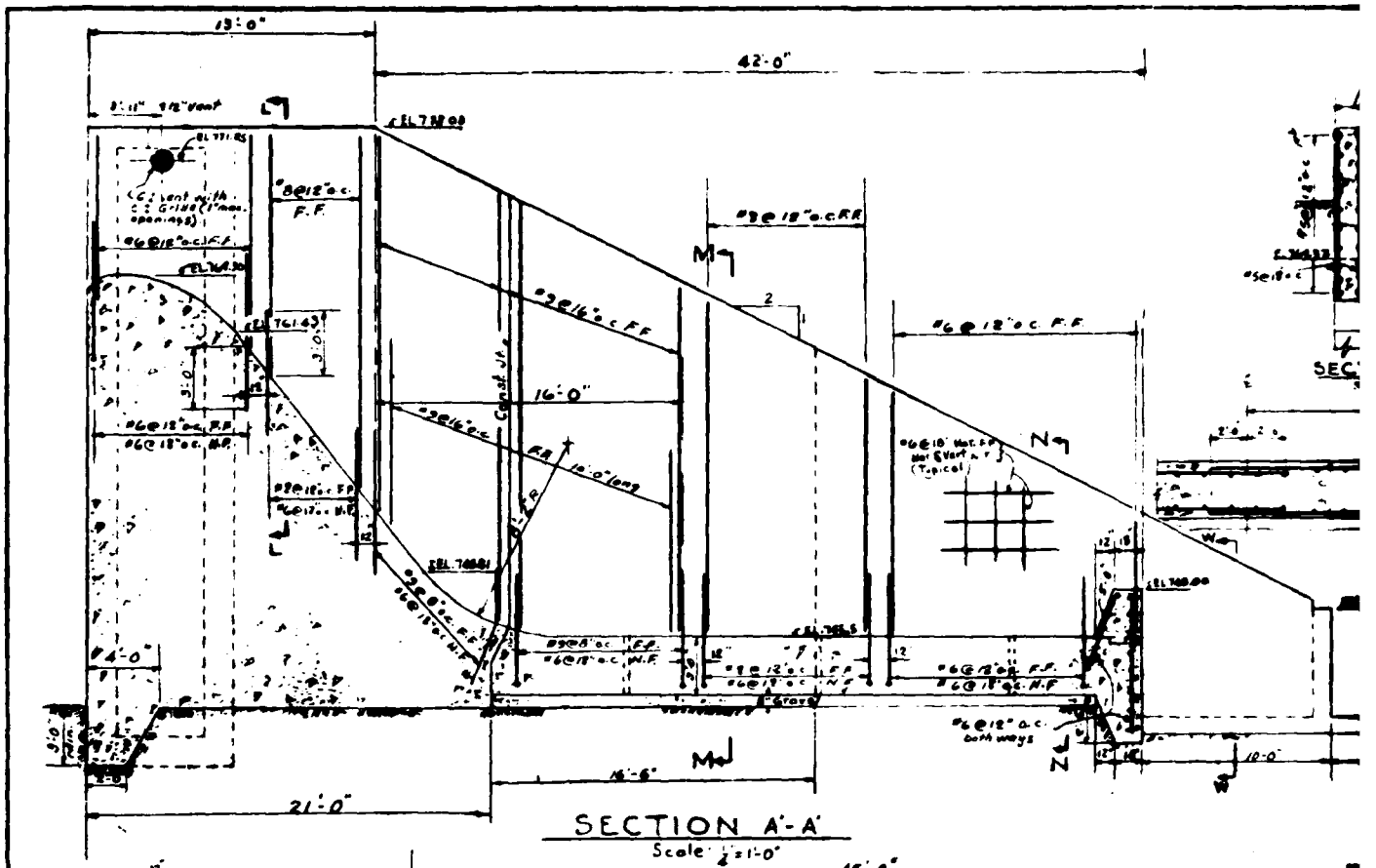
SCALE AS SHOWN

CHAS. T. MAIN, INC.

BOSTON, MASSACHUSETTS CHARLOTTE, NORTH CAROLINA

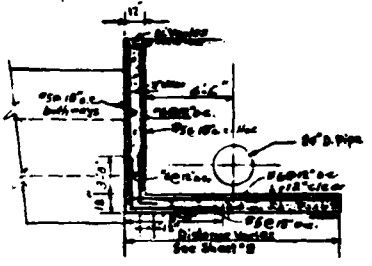
District Waterways Engineer

CONTRACT NO. 1841 ACC. 03866-A



SECTION A'-A'

Scale $\frac{1}{2}$"=1'-0"

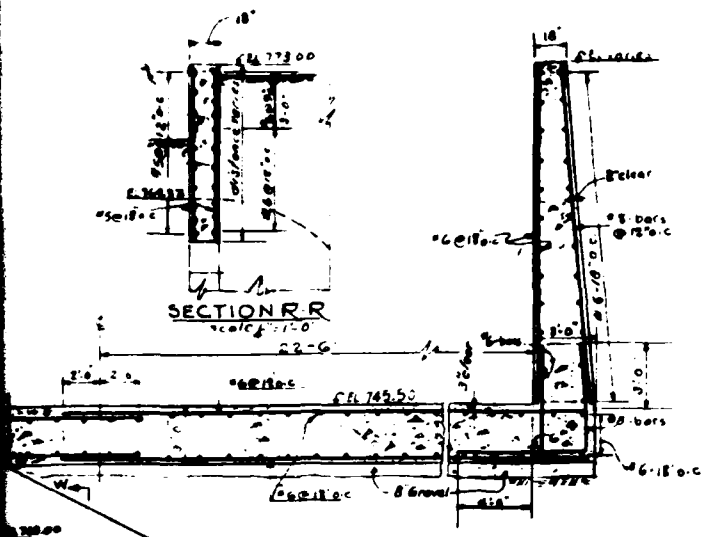


SECTION W-W

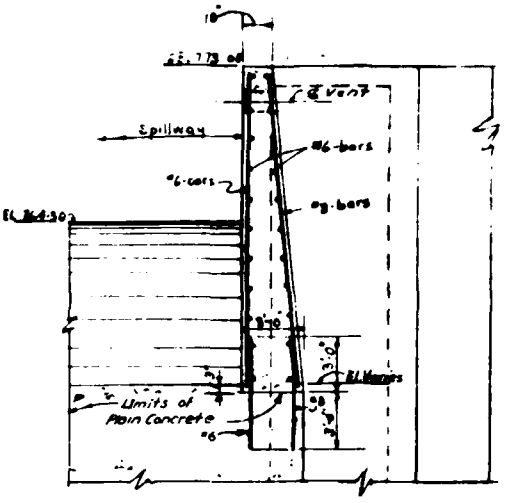
Scale $\frac{3}{4}$"=1'-0"

SECTION D'-D'

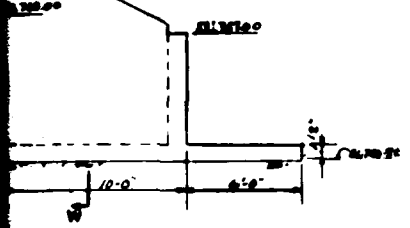
Scale $\frac{1}{2}$"=1'-0"



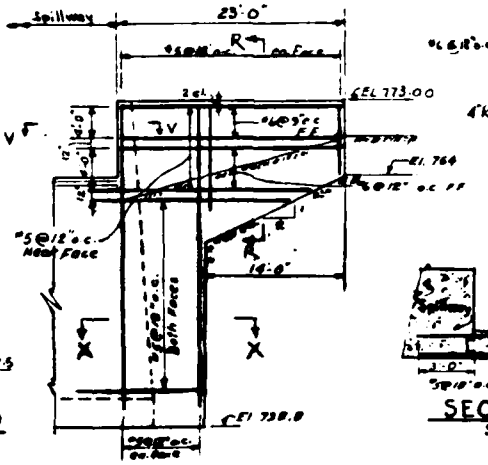
SECTION R-R
Scale 1/4" = 1'-0"



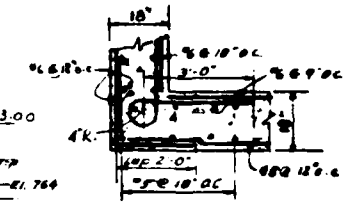
SECTION L-L
S-S Similar, Opp Hand
Scale 1/4" = 1'-0"



SECTION M-M
T-T Opp. Hand
Scale 1/4" = 1'-0"

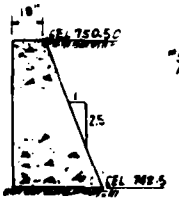


ELEVATION P-P
Scale 1/8" = 1'-0"

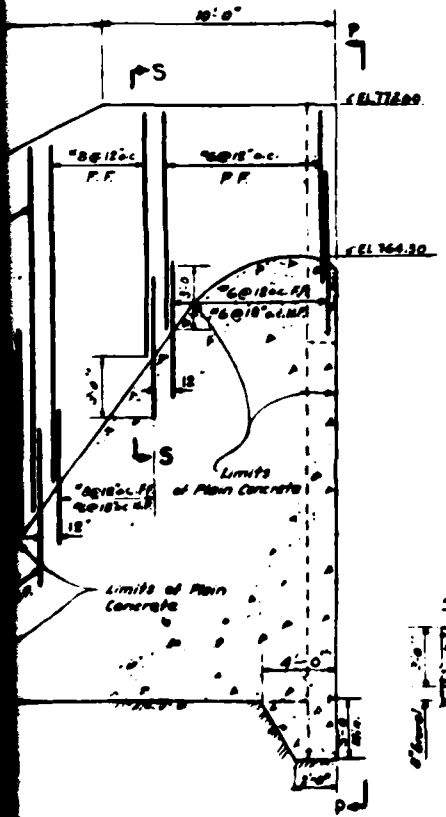


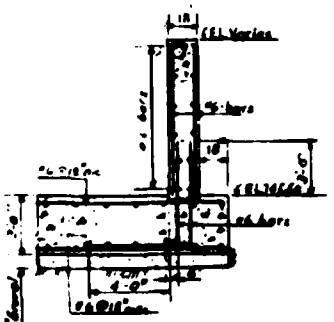
SECTION V-V
Scale 1/4" = 1'-0"

SECTION X-X
Scale 1/4" = 1'-0"



SECTION O-O
Scale 1/4" = 1'-0"





SECTION N-N
U-U Opp. Hand
Scale 1/4" = 1'-0"

NOTE:
Chain link fence not shown on this sheet. See PLAN, ELEVATION & SECTIONS and SECTIONS & DETAILS - SH. 2.

NOTE: DRAWING HAS BEEN REDUCED FOR THIS REPORT.

FIGURE B-2

PROPOSED DAM RESTORATION

GLENECHO LAKE

CHARLTON

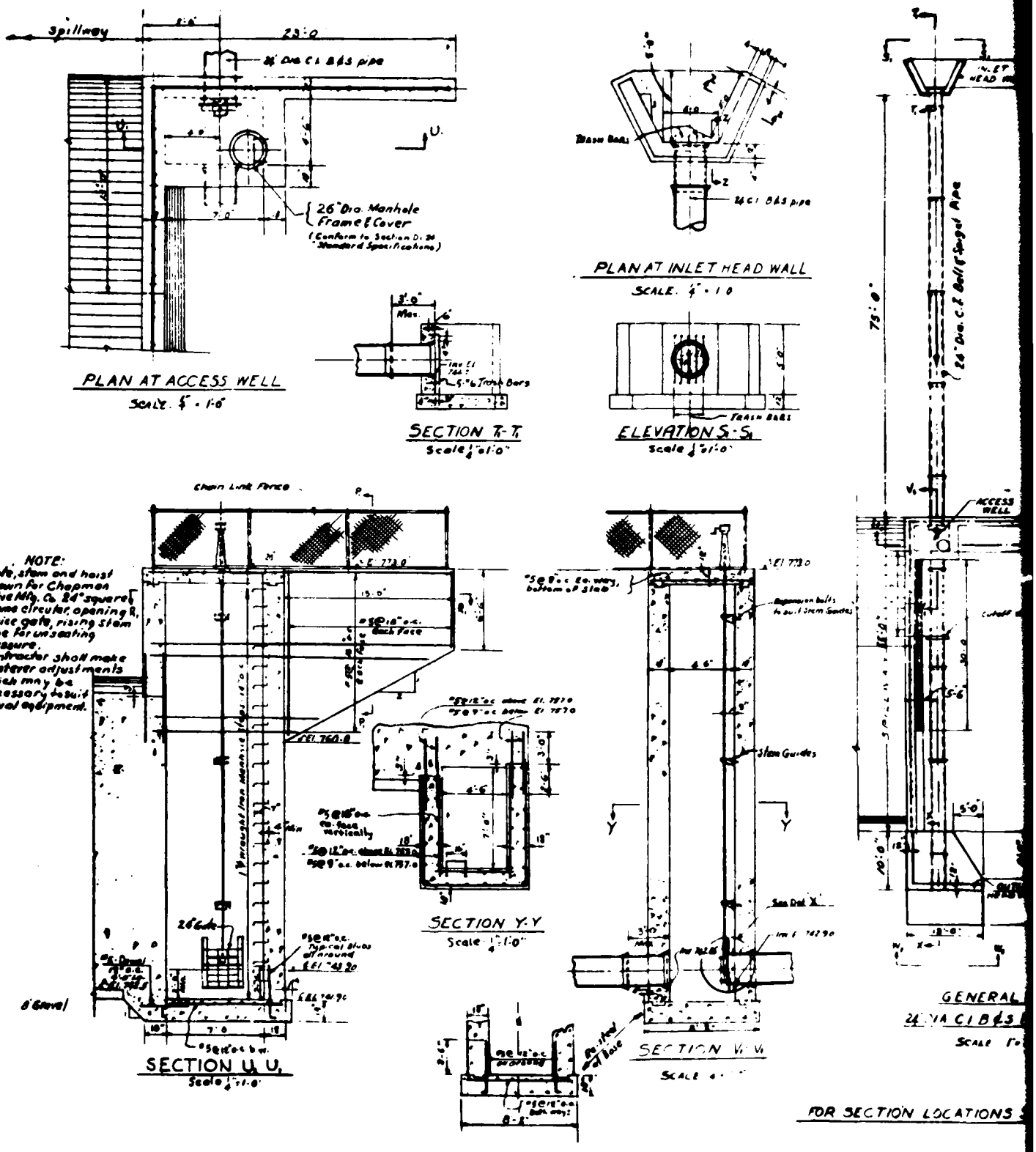
SECTIONS & DETAILS - SH. 1

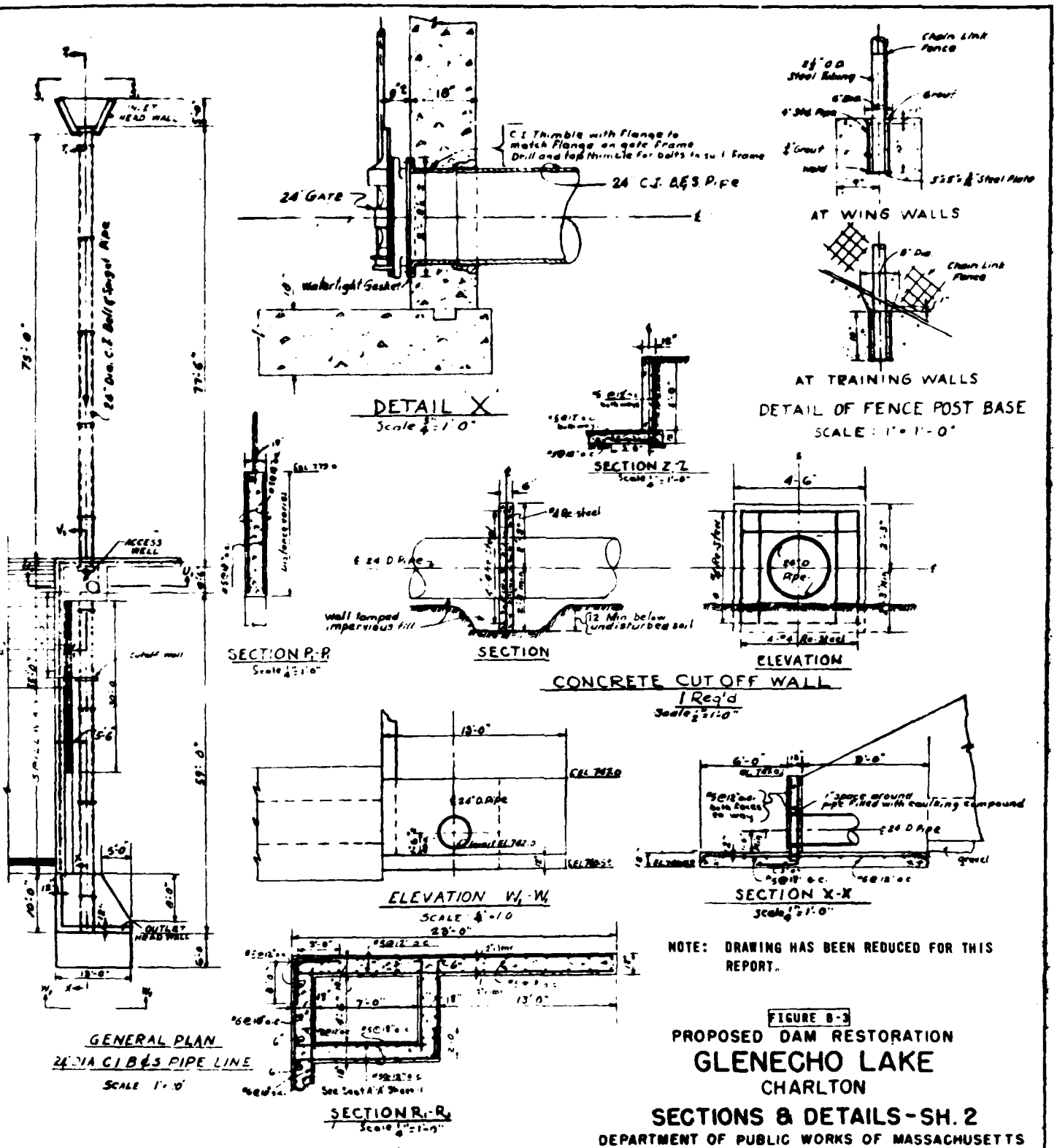
DEPARTMENT OF PUBLIC WORKS OF MASSACHUSETTS
DIVISION OF WATERWAYS
AUGUST 1956
SCALE AS SHOWN

CHAS. T. MAIN, INC.
BOSTON, MASSACHUSETTS CHARLOTTE, NORTH CAROLINA

District Waterways Engineer

CONTRACT NO 1641 | DAM NO 10-12 | ACC. 03586-B


Spillway
23'-0
24" Dia C.I. B&S pipe
26" Dia. Manhole Frame & Cover
(Conform to Section D: 24 "Standard Specifications")
PLAN AT ACCESS WELL
SCALE: 1/4" = 1'-0"
PLAN AT INLET HEAD WALL
SCALE: 1/4" = 1'-0"
Trash Bars
SECTION T-T
Scale 1/4"=1'-0"
ELEVATION S-S
Scale 1/4"=1'-0"
Chain Link Fence
NOTE:
Gate, stem and hoist shown for Chapman Valve Mfg. Co. 24" square frame circular opening R. sluice gate, rising stem type for unseating pressure.
Contractor shall make whatever adjustments which may be necessary to suit actual equipment.
SECTION U-U
Scale 1/4"=1'-0"
SECTION Y-Y
Scale 1/4"=1'-0"
SECTION V-V
SCALE
24" Dia. C.I. Bell & Spigot Pipe
ACCESS WELL
GENERAL
SCALE
FOR SECTION LOCATIONS



NOTE: DRAWING HAS BEEN REDUCED FOR THIS REPORT.

FIGURE B-3

PROPOSED DAM RESTORATION

GLENECHO LAKE

CHARLTON

SECTIONS & DETAILS - SH. 2

DEPARTMENT OF PUBLIC WORKS OF MASSACHUSETTS
DIVISION OF WATERWAYS

AUGUST 1956

SCALE AS SHOWN

CHAS. T. MAIN, INC.
BOSTON, MASSACHUSETTS CHARLOTTE, NORTH CAROLINA

District Waterways Engineer

CONTRACT NO. 1641	DAM NO 10-12	ACC. 03566-C

TOWN OR CITY Charlton DECREE NO. 54 Filed July 9 1869 PLAN NO. DAM NO. 10-12

LOCATION ½ Mile North Charlton City off State Hy to Depot C. C. DOCKET NO.

DESCRIPTION OF DAM El. 100'.

Type	Rubble wall - Earth Fill - riprap.
Length	180'-200'.
Height	21'.
Thickness top	offset-7'down 17-18' - top 15.
" bottom	40'±
Downstream Slope	Vertical in two offsets
Upstream "	riprap 2:1
Length of Spillway	El. crest = 96.2 18'.
Size of Gates	2 x 3' high. El. 79.±
Location of Gates	Near East End.
Flashboards used	El. 97.0 Yes
Width Flashboards or Gates	10".
Dam designed by - redesign spillway	John C. Clarke - 1938
" constructed by	Charlton Woolen Co. 1938
Year constructed	Double wall built 1870. 1860

GENERAL REMARKS

(Owned by Geo. C. Prouty etc.
(Inspected Jan. 5, 1925. L.O. Marden.
Owned by Charlton Woolen Co., & ¼
Mr. N. H. Prouty. ¼
Inspected Feb. 12, 1928 - / L.O. Marden.
" Aug 4 1930 - / " Lamb & Grimwade
" Dec. 28, 1931 - / "
" Sept. 19, 1933 - / " & R. Grimwade
" Nov. 11, 1936 - "

DESCRIPTION OF RESERVOIR & WATERSHED

Name of Main Stream	Cady Brook-(Hicks Pond.
" " any other Streams	(348
Length of Watershed	M - June 1902
Width " "	F. - Aug. 1, 1902
Is Watershed Cultivated	(Traced by: R. M. Finlayson
Percent in Forests	(Checked by: L. O. Marden
Steepness of Slope	Narrow wooded valley.
Kind of Soil	Rocky hardpan.
No. of Acres in Watershed	2.87 Sq. M
" " " " Reservoir	0 58.
Length of Reservoir	
Width " "	Gates - R. Grimwade % Charlton Woolen Co
Max Flow Cu. Ft per Sec.	
Head or Flashboards-Low Water	Now Glen Echo Pond
" " " -High	" Rebuilt 1957

GENERAL REMARKS

Filed C. Comm. office (Blueprint)
New Plan & Spec. approved by C.C.

1938 High water 12" below present top.

Insp. + Meas: Oct. 5, 1938 B. P. St. J
Measured: 3-23-39 by E. C. Corcoran & Manly
Inspected: Dec. 13. 1940. W.O.L.

2-Library Bureau 10-92260

B-4

PREVIOUS INSPECTIONS (PARTIAL LISTING)

COPY OF INSPECTION CARD ON FILE AT THE MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS, DISTRICT OFFICE, WORCESTER.

Inspected: Dec. 30, 1941 - B.P.S.J. 10-12
" : Dec. 10, 1942 - K.M.F.
" : Dec. 12, 1945 - LHS,
" : Nov. 26, 1947 - Grimwade - LDM
" " 29, 1951 - LHS2
Mar 29, 1954 - "
" Feb. 10, 1960 - ZDM.
OWNER - TOWN OF CHARLTON
INSPECTED - 2/17/72 - NICHOLSON & MULCAHY

PREVIOUS INSPECTIONS (PARTIAL LISTING)

COPY OF INSPECTION CARD ON FILE AT THE MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS, DISTRICT OFFICE, WORCESTER.

INSPECTION REPORT & DATA FOR DAMS

Dam No. 54-12
Town: Charlton
Stream: Cady Brook
Pond: Glen Echo Lake
Date: 2/17/72
By: R. Nicholson

Owner: Town of Charlton
His Address: Board of Selectmen
Function of Dam: RECREATION

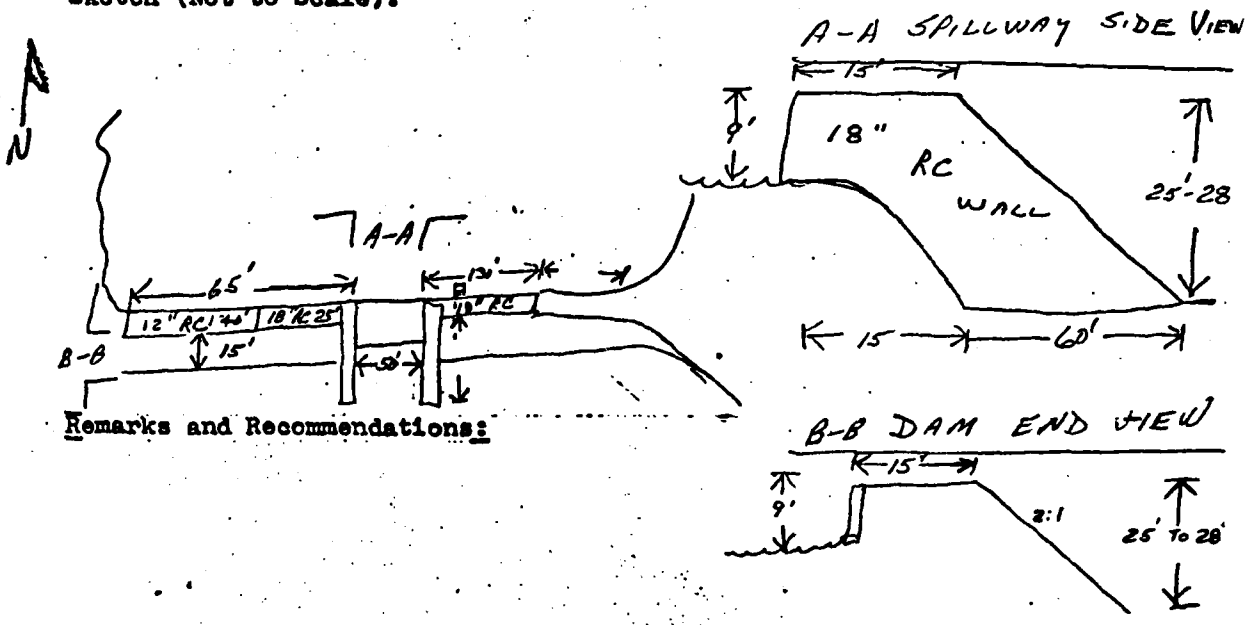
Location & Access: 0.3 Mile North on Access Rd. off Brookfield Rd.
USGS Quad. Leicester Lat. 42°09'22" Long. 71°59'35"
Drain.Ar.: 2.87 Sq.Mi.; Ponds: ___ ac.; Res.@dam: 58.00
Character of D.A.:

CONDITION RATING
Structural: GOOD
Hydraulic: 50' X 9'
General: GOOD
PRIORITY: NONE

Estimated Discharge Capacity:

General Description of Dam and Discharge Control:
12" + 18" RC EARTH BACKFILLED DAM. GATE & GATE CONTROL EAST OF SPILLWAY. SIZE OF GATE UNKNOWN AS IT IS UNDER ICE.

Sketch (Not to Scale):



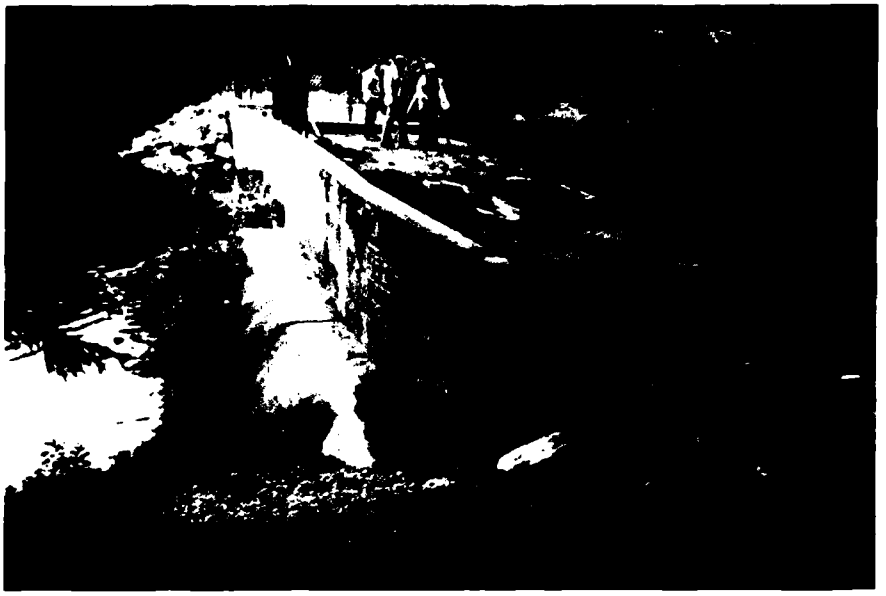
Remarks and Recommendations:

Date	By	Comment
2/17/72	R. Nicholson E.N	

Dam No. 3-14-54-12

APPENDIX C

PHOTOGRAPHS



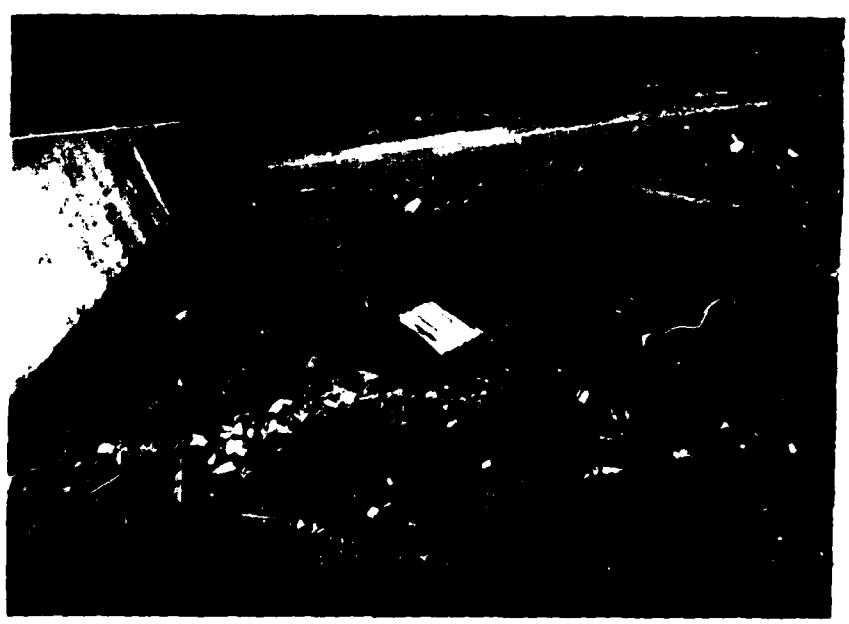
NO. 1 VIEW OF CREST OF DAM FROM WEST ABUTMENT

NO. 2 VIEW OF UPSTREAM CONCRETE WALL WEST OF SPILLWAY

NO. 3 VIEW OF EAST ABUTMENT OF SPILLWAY

NO. 4 VIEW OF DOWNSTREAM END OF OUTLET CONDUIT

NO. 5 VIEW OF SPILLWAY



NO. 6 VIEW OF STILLING POOL BELOW SPILLWAY

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Project Nat. Review of Non Fed. Dams Acct No 6036 Page 1 of 5
Subject Worcester Mass. Area Compld. By LEE Date 9/19/78
Detail GLEN ECHO LAKE DAM Ck'd By RW Date 10/9/78

(I) Test Flood, 100 year Storm & Storage Functions

1- Total Drainage Area - 2.87 mi²

2- Ponds & Swamps - 0.18 + .01 + .02 = 0.21 - Ponds
0.02 + 0.04 + .08 + .03 = .17 - Swamps
0.38

% Ponds & Swamps = $\frac{0.38}{2.87}$ = 13%

3- $\frac{1090 - 764}{9400}$ = 3.47% } Say Ave Slope = 4%

4- Using C. of E. Curves for Peak Flow Rates & above guide values the Peak Flow Rate was estimated to be between Rolling and Flat, and taken at 1500 c.f.s./mi²

Use full PMF as Test Flood

5- Test Flood Inflow = (1500) 2.87 = 4300 c.f.s.

6- Storage

Pond area is 0.18 mi². Thus a one foot rise in pond level equals 115.2 acre feet of storage (Assume pond area remains constant)

7- Storage Functions are based on $Q_{out} = Q_{in}\left[1 - \frac{S_{out}}{R}\right]$

S_{out} = Storage Vol. in Reservoir related to final Q_{out} in terms of inches of rain over the drainage area.

S(in Inches) = $12 D \left(\frac{0.18}{2.87}\right) = 0.75 D$; R = 6hr rain of storm

D = Storage Depth (above spillway) on reservoir, in feet

8- Storage Functions: (F_{TF}) ; D = 0 @ Pond El. 764

$F_{TF} = 4300 - 226 S = 4300 - 170 D$

Project Nat. Review of Non-Fed. Dams Acct. No. 6036 Page 2 of 5
Subject Worcester Mass. Area Compt'd By LEB Date 9/21/78
Detail GLEN ECHO LAKE DAM Ck'd By RW Date 10/2/78

(II) Dam Discharge Ratings

A - Spillway Discharge

[Ref V.T. Chow "Open Chan Flow", pg 365 et seq]

Net Width = $45' - 2(1) H_{crest} = L_N$; $Q = C L_N H_{crest}^{1.5}$

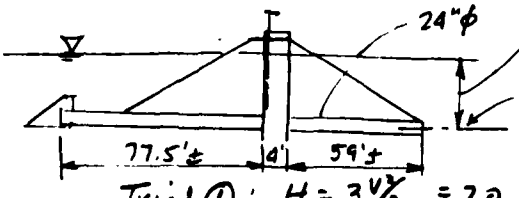
$h/H_{des.} = \frac{26\pm}{1' \text{ to } 7'\pm} >> 1.33$; Use $C = C_{des} = 4.03$ for any H_{crest}

$Q = 4.03 (45 - 0.2 H_c)(H_c^{1.5})$; Pond Elev. $= 764.3 + H_c$; $(H_{vel.} \simeq 0)$

or $Q = 181.35 H_c^{1.5} - 0.806 H_c^{2.5}$

H_c	1'	2'	3'	4'	5'	6'	7'	8'	9'
Q	180	510	930	1425	1980	2590	3250	3960	4706
Pond El.	765.3	766.3	767.3	768.3	769.3	770.3	771.3	772.3	773.3

B - Outlet Pipe [Ref. William & Hagen "Hydr. Tables"]



Minor Losses:
2 Ent & 2 Exit - Say $3.0 \frac{V^2}{2g}$

Frict. Losses: Use C = 110 in Hagen William
with Pond @ El. 764.5, H = 20'

Trial ①: $H = 3\frac{V^2}{2g} = 20$; V = 20.7 fps, Q = 65 cfs

Check: $\left(\frac{h_L/1000}{32.8}\right)^{.54} = \frac{65}{46.42}$; $h_L/1000 = 86.6'$, $h_L = 11.82'$

Trial ②: Allow $h_L' = 6'$; $\frac{20-6}{3}(2g) = V^2$, V = 17.3, Q = 54.5 cfs.

check: $h_L/1000 = 32.8\left(\frac{54.5}{46.42}\right)^{1.852} = 44.09$; $h_L = 6.02'$ - OK!

With Pond @ 0.5' above spillway crest, low level outlet pipe discharges 54.5 cfs or 1.9 c.s.m

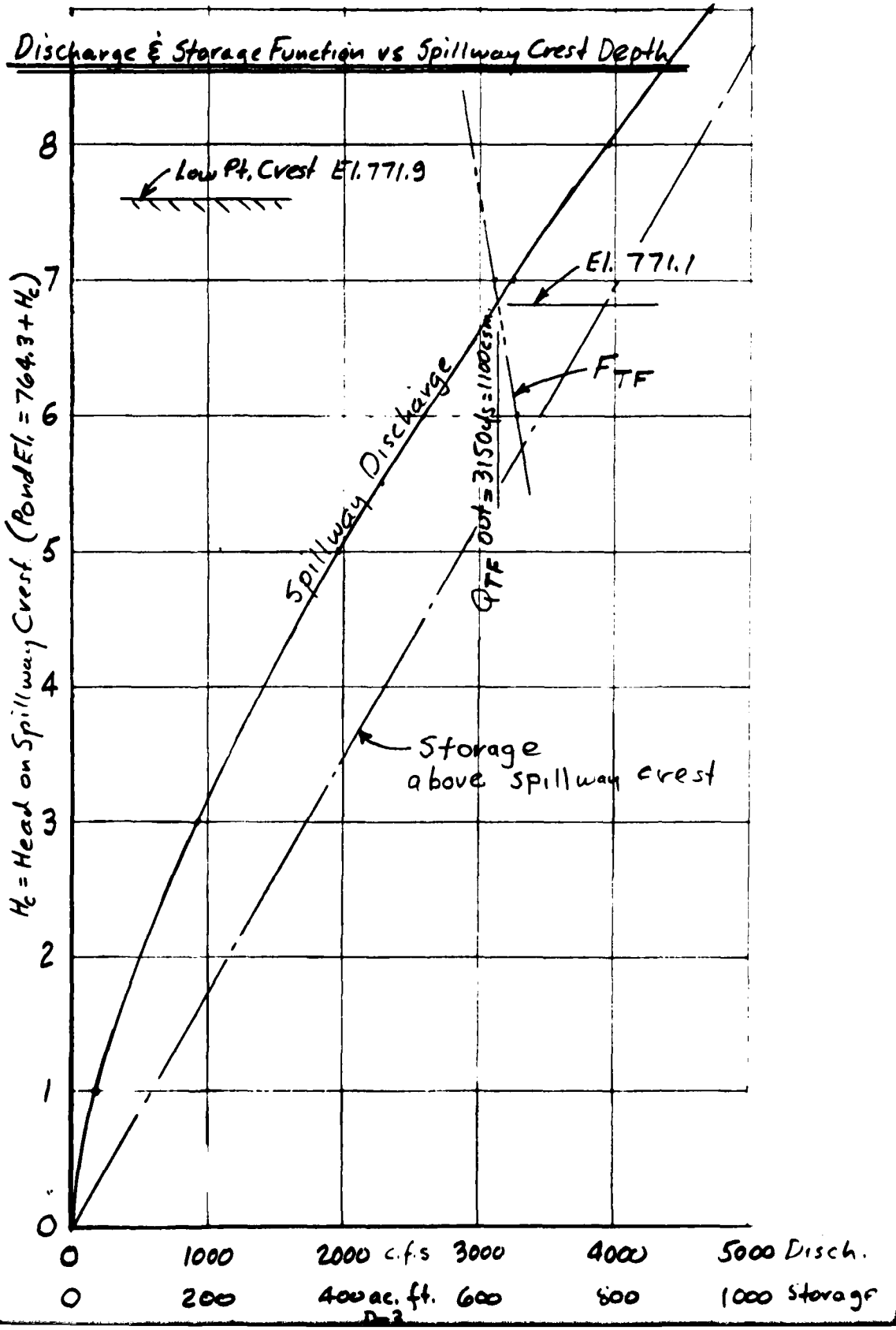
Rate of Res. Fall: $\frac{0.18(640)43560(1)}{54.5(3600)} = 25.6$ hours/ft of drop

Peak outlet rate above is 1.7% of Test Flood outflow

METCALF & EDDY, ENGINEERS

Project Nat. Review of Non. Fed. Dams Acct No. 6036 Page 3 of 5
Subject Worcester Mass. Area Comptd By LEB Date 9/21/78
Detail GLEN ECHO LAKE DAM Ck'd. By RW Date

(III) Discharge & Storage Function vs Spillway Crest Depth

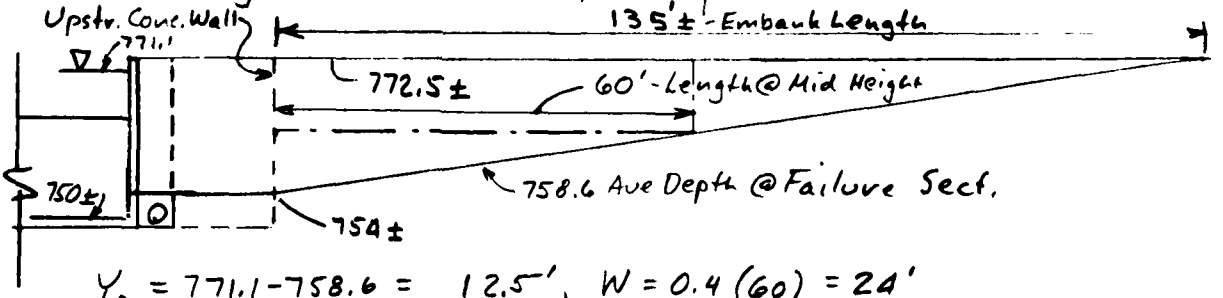


METCALF & EDDY, ENGINEERS

Project	Nat Review of Non-Fed. Dams	Acct No	6036	Page	4 of 5
Subject	Worcester Mass. Area	Comptd By	LEB	Date	9/22/78
Detail	GLEN ECHO LAKE DAM	Ck'd By	RW	Date	10/9/78

(IV) Dam Failure

Assume washout of easterly embankment.
Omit gravity concrete spillway & short west embankment



$Y_{o_{PMP}} = 771.1 - 758.6 = 12.5'$, $W = 0.4(60) = 24'$

$Q_{P_1} = 1.68(24)(12.5)^{1.5} = \underline{1780 \text{ cfs}}$ for P.M.P Flood

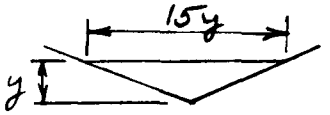
$Y_{o_{TF}} = 768.4 - 758.6 = 9.8'$; $Q_{P_1} = 1.68(24)(9.8)^{1.5} = \underline{1240 \text{ cfs for Test Flood}}$

Failure of East Embankment would release peak flows less than the associated Test Flood or P.M.P. Flood. Nearest residences are ± 2000' down stream and about 15' above the stream channel at that point.

$Y_{o\,Full} = 764.3 - 758.6 = 5.7'$; $Q_{P_1} = 1.68(24)(5.7)^{1.5} = 550$ cfs.

Project Nat. Rev. of Non Fed. Dams Acct No. 6036 Page 5 of 5
Subject Worcester Mass. Area Comptd By LEB Date 9/22/78
Detail GLEN ECHO LAKE DAM Ck'd. By [illegible] Date [illegible]

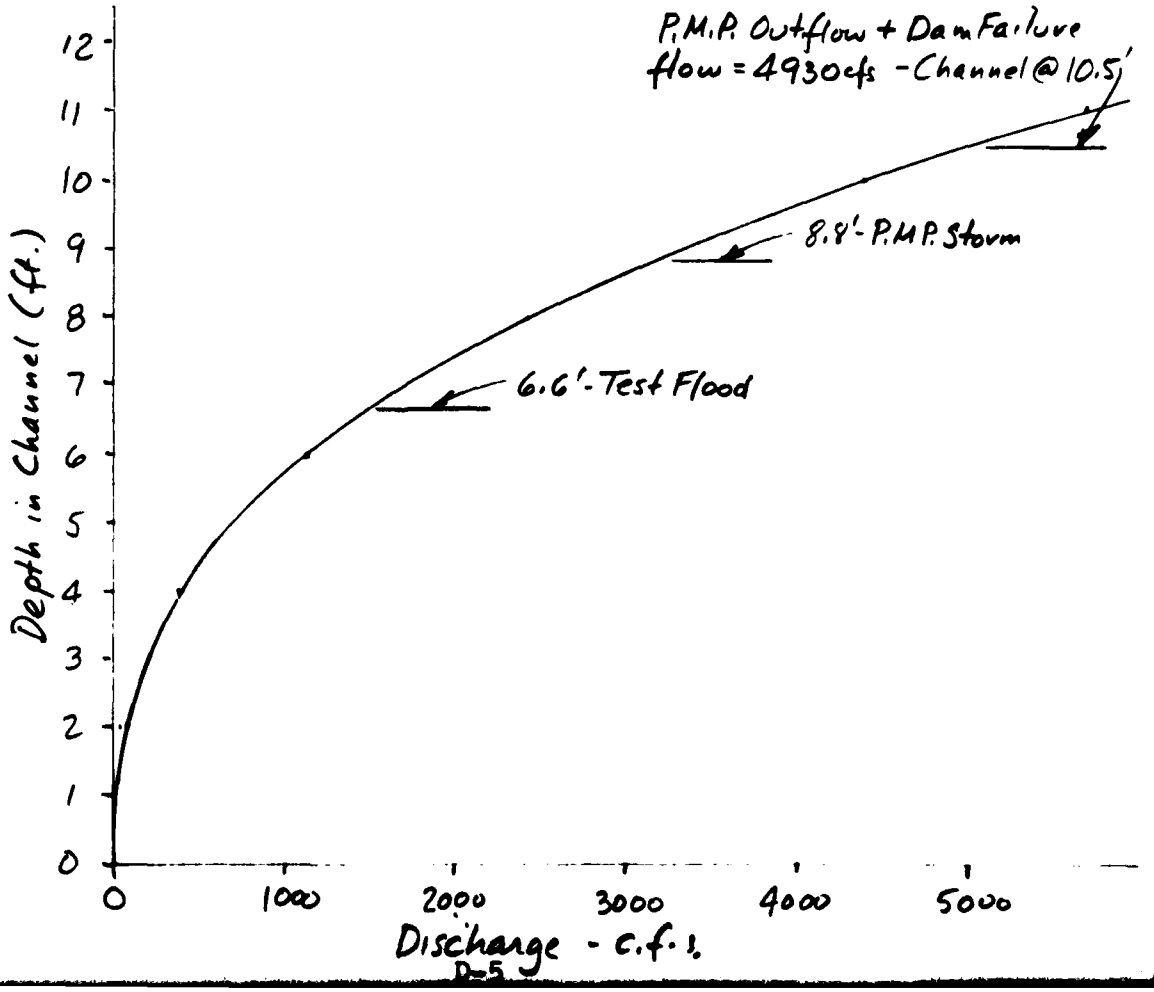
(I) Downstream Channel Characteristics



$S = \frac{10'}{800'} = .0125$; $n = .08$; $V = 2R^{2/3}$

$A = 7.5y^2$; $P = 15.1y$

y	A	P	$R^{2/3}$	Vel.	Q
2	30	30.2	1	2	60
4	120	60.4	1.58	3.16	380
6	270	90.6	2.07	4.14	1120
8	480	120.8	2.51	5.02	2410
10	750	151.0	2.91	5.82	4370
12	1080	181.2	3.29	6.57	7100
11	907.5	166.1	3.10	6.20	5630



METCALF & EDDY, ENGINEERS

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST	(7) STATE	(8) COUNTY	(9) CONGR DIST	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY | MO | YR
MA	191	NED	25	027	02				GLEN ECHO LAKE DAM	4209.4	7159.5	20OCT78

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	07	CADY BROOK	CHARLTON CITY	0	5600

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE–FT.)	(27) NORMAL (ACRE–FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
RECTPG	1957	R	39	39	1670	820	NED	N	N	N	N	4DEC78

(28) REMARKS

(29) DIS HAS	(30) SPILLWAY LENGTH (FT.)	(31) TYPE	(32) WIDTH (FT.)	(33) MAXIMUM DISCHARGE (FT.)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) PROPOSED (MW)	(37) NAVIGATION LOCKS NO	(38) LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
2	250	O	45	3600	11300											

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
CHARLTON WOOLEN COMPANY	CHARLES T MAIN INC	MASS DEPT PUBLIC WORKS

(49) REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

(52) INSPECTION BY	(54) INSPECTION DATE DAY | MO | YR	(55) AUTHORITY FOR INSPECTION
METCALF + EDDY, INC	31AUG78	PUBLIC LAW 92-367

(56) REMARKS